# Climate of North Dakota

## Introduction

This publication consists of a narrative that describes some of the principal climatic features and a number of climatological summaries for stations in various geographic regions of the State. The detailed information presented should be sufficient for general use; however, some users may require additional information.

The National Climatic Data Center (NCDC) located in Asheville, North Carolina is authorized to perform special services for other government agencies and for private clients at the expense of the requester. The amount charged in all cases is intended to solely defray the expenses incurred by the government in satisfying such specific requests to the best of its ability. It is essential that requesters furnish the NCDC with a precise statement describing the problem so that a mutual understanding of the specifications is reached.

Unpublished climatological summaries have been prepared for a wide variety of users to fit specific applications. These include wind and temperature studies at airports, heating and cooling degree day information for energy studies, and many others. Tabulations produced as by-products of major products often contain information useful for unrelated special problems.

The Means and Extremes of meteorological variables in the Climatography of the U.S. No.20 series are recorded by observers in the cooperative network. The Normals, Means and Extremes in the Local Climatological Data, annuals are computed from observations taken primarily at airports.

The editor of this publication expresses his thanks to those State Climatologists, who, over the years, have made significant and lasting contributions toward the development of this very useful series.

**State and Station Normals are available at:**
**http://www5.ncdc.noaa.gov/cgi-bin/climatenormals/climatenormals.pl**

**Visit our Web Site for other weather data: www.ncdc.noaa.gov**

Non-Subscription Request:
Climate Services Branch
National Climatic Data Center
151 Patton Avenue
Asheville, North Carolina 28801-5001
Telephone: 828-271-4800
Facsimile: 828-271-4876
E-mail: **ncdc.orders@noaa.gov**
TDD: 828-271-4010

Hard Copy Subscription Request:
NCDC Subscripting Service Center
310 State Route 956
Building 300
Rocket Center, West Virginia 26726
Toll-Free Telephone:
866-742-3322

## Climate of North Dakota

Topographic Features- North Dakota is subdivided into four main physiographic regions: the Great Plains, the Missouri Coteau, the Glaciated Plains, and the Red River Valley. Southwestern North Dakota is part of the relatively flat Great Plains which slope gently westward toward the Rocky Mountains. The land surface in this area consists of hilly to gently rolling plains with occasional buttes. The surface, including the famous North Dakota Badlands, has local relief of 300 to 500 feet which was shaped by erosion. The Missouri Coteau is a 30 to 70 mile wide strip extending diagonally from the northwest corner of the State to the south-central border that marks the furthest advance of glacial ice. It consists of steeply rolling topography with 300 to 500 feet of local relief that is primarily used for rangeland. The Glaciated Plains, which cover much of the remainder of the State, consist of gently rolling glaciated landscapes. Local relief in the Glaciated Plains is typically less than 25 feet, but it is occasionally punctuated by streams and moraines with relief ranging up to 100 feet. The Red River Valley is an extremely flat glacial lake plain extending westward for about 25 to 40 miles from the eastern border and is noted for its highly productive farmland. Elevation in the Red River Valley ranges from 780 feet above mean sea level at Pembina in the north to 962 feet at Wahpeton in the south. The terrain gradually rises to about 3,000 feet in the southwestern part of the State.

North Dakota watersheds and rivers fall into two major groups – those in the west and south-central that drains into the Missouri River and those in the east and north-central portions that drain into the Red River of the North. Major Missouri River tributaries are the: Cannonball, Grand, Heart, Knife, Little Missouri and James. Local floods occur occasionally on all the tributaries and are mainly associated with spring snowmelt or heavy summer rainfall. Serious flooding due to heavy rainfall also occurs from time to time. The completion of the Garrison Dam in the 1950s, located about 60 miles north of Bismarck, greatly reduced the extent and danger of Missouri River flooding.

The streams draining the east and north-central portions of North Dakota flow into the Red River of the North, which carries the water north into Canada and ultimately into Hudson Bay. The most important tributaries of the Red River in eastern North Dakota are the Sheyenne and Pembina. The north-central region is drained by the Souris River which originates in Saskatchewan, flows southeastward into North Dakota, makes a large loop back to the north, and returns to Canada where the water eventually flows into the Red via the Assiniboine River. Floods in the Red River basin occur primarily during April and May and are caused by rapid spring snowmelt which may be accompanied by rain. In general, the later snowmelt begins in spring the more likely it will be accelerated by high temperatures and/or rainfall making flooding more likely.

North Dakota's climate is characterized by large temperature variation across all time scales, light to moderate, irregular precipitation, plentiful sunshine, low humidity and nearly continuous wind. Its location at the geographic center of North America results in a strong continental

climate which is exacerbated by the mountains to the west. The mountains greatly reduce maritime effects on North Dakota's climate by blocking some of the cool, moist Pacific Ocean air masses from moving eastward, or by extensively modifying the temperature and water content of those that do. However, there are no barriers to the north or south so air masses from these directions easily overflow the State with little temperature or water content modification. Thus, in every season, and in every year cold, dry air masses originating in the far north, warm, humid air masses originating in tropical regions, or modified mild, dry air masses from the northern Pacific regularly overflow the State. Movement of these air masses and their associated fronts causes nearly continuous wind and often results in large day to day temperature fluctuations in all seasons. This temperature variation is perhaps the most important feature of North Dakota's climate.

Temperature- The annual average temperature ranges from about 37 degrees Fahrenheit (° F) in northeastern North Dakota to 44 along most of the southern border. However, annual averages are misleading because they hide the large seasonal temperature variations common throughout the State. January is the coldest month with average temperatures ranging from near 0 in the northeast to 15 in the southwest. The warmest month is July when average temperatures range from 65 in the northeast to 72° F in the south. However, average August temperatures are only a degree or two less than July's. The average annual temperature range (difference between July and January average temperatures) is very large, ranging from about 65° F in the east and northeast to 56 degrees in the southwest. It clearly illustrates the pronounced continental climate of the region.

Summer days are usually warm or even hot on occasion. The average number of days per year with maximum temperatures of 90° F or more ranges from 10 in the northeast to 24 in the west and south. Temperatures of 100° F or more occur nearly every year somewhere in the State, but they are most prevalent in the drier southwest and south-central regions where they average about two days per year. In the wetter east and northeast regions 100° F occurs only about once every four or five years. The State's highest temperature ever recorded was 121° F at Steele on July 6, 1936.

Winter temperatures are extremely variable in North Dakota depending on the air mass source and the extent of snow cover. In most years snow cover is widespread and when combined with arctic air masses, very low temperatures are common. Subzero temperatures average about 40 to 70 days a year across the State. The lowest temperature ever recorded was -60° F at Parshall on February 15, 1936. However, in years with little snow cover, air masses from the west or south produce winter temperatures in the 40s, 50s and even 60s. For these reasons winter frontal passages often cause drastic temperature changes. Subzero temperatures have occurred as early as late October and as late as early April. Similarly 90° F days have occurred in April and October. As is evident from these winter and summer extremes, autumn and spring frontal passages often cause high winds and extreme weather conditions.

The average growing season is about 110 days in the northeast and north-central regions increasing to 120 days over most of the rest of the State. It reaches 130 days in the southeast and south-central. The average date of the last freeze in spring ranges from May 15 in the south to late May in the north and northeast. In the fall, the first 32° F or lower temperature occurs

between September 10 and 25. However, freezing temperatures have occurred as late as mid-June and as early as mid-August.

Precipitation- Average annual precipitation ranges from about 14 to 22 inches from northwestern to southeastern North Dakota. This increase reflects the decreasing distance to the Gulf of Mexico which is the water source for most of the State's precipitation. On an average, about 75 percent of the annual precipitation falls during the crop-growing season, April to September, and 50 - 60 percent falls during April through July. The coldest months, November through February, average only about 0.50 inch per month, mostly as snow.

Measurable precipitation (0.01 inch or more) occurs on an average of 65 to 100 days during the year, but over 50 percent of these events produce less than 0.10 inch. Although there are fewer precipitation days in the northwest portion of the State, there is no statewide, defined rain day pattern. Most of the summer rainfall is produced by thunderstorms which occur on an average of 25 to 35 days per year. In most years at least some part of the State experiences a severe storm that brings a rainfall of two to three inches in 24 hours, and occasionally five or six inches or more can fall in one day. Often these more severe storms may produce hail and/or tornadoes. On the average, it rains on one of every three or four days during the summer.

Despite its northerly location, North Dakota's annual snowfall of 25 to 45 inches is less than other northern states. Winter snowpack, although persistent from December through March, only averages nine to 15 inches from southwest to northeast. The average date for the first three inches of snow cover is late November to early December. Contrary to widespread belief, blizzards are not frequent events in North Dakota. On the average there are only two to three blizzards per year in the State. In addition, blizzard conditions seldom last more than two days although a few famous ones have persisted for four days. During blizzard conditions, advancing cold air is accompanied by strong winds that quickly fill the air with fine snow that reduces visibility to only a few feet at times. Even today, when blizzards strike, travelers and snow plows seek shelter as major highways are closed. Although blizzards were rare in the 1980s and most of the 1990s, during the winter of 1996 - 1997 there were nine blizzards and four winter storms producing all-time record snowfalls of 60 to 120 inches over most of the State.

In the east, the prevailing winds are from the north to north-northwest during winter and from the south to south-southeast during summer. In the rest of the State, prevailing wind directions are west, northwest and north during most of the year although this depends somewhat on the season. During the summer winds blow from the south a significant amount of time which is how the moist air for North Dakota's rainfall is transported. Average wind speeds range from 10 to 13 mph which doesn't seem very high, but the air is rarely calm in the Northern Great Plains. The windiest months are April and May while July and August are the calmest. Humidity is usually low during summer afternoons and dewpoint temperatures are rarely greater than 70° F. Dense fogs are experienced on average 10 to 13 days. Percent of possible sunshine is 70 to 75 percent during July and August, and averages about 60 percent for the entire year.

Climate and the Economy- North Dakota is a rural state, ranking 4th in the nation for total cropland harvested, and 10th for cattle production. The State's soils are very productive, even though yields are often limited by lack of water. In addition, long hours of summer sunshine

make it possible to grow many crops in what appears to be a comparatively short growing season. Among all states, North Dakota ranks first in the production of: durum wheat, spring wheat, oats, barley, canola, sunflower, flax and dry edible beans, second in honey produced, third in sugar beets, fourth in potatoes, and 10th for alfalfa hay production. In addition, soybeans, corn and specialty crops such as: safflower, rye, mustard, buckwheat, millet and others are produced.